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Scientist from CTP PAS Developed Theory of Superior Quantum Light

Juan Camilo López Carreño, PhD, from the Centre for Theoretical Physics of the Polish Academy of Sciences has made an important discovery in research on light-matter interaction. Results published in the prestigious international scientific journal "Laser & Photonics Reviews" confirm that specially prepared quantum light has a significant advantage over classical (laser) light. This discovery constitutes a starting point for the development of future quantum technologies.

The Secret of Better Light

López Carreño investigates how light behaves at the smallest scales – where the laws of quantum physics prevail. In his theoretical research, he analyses what happens when a very short laser pulse strikes an extremely small structure. This structure then emits its own light – with very special properties.

The scientist analysed in detail how light properties change depending on experiment parameters. It turned out that quantum light – that is, light originating from another quantum source – delivers better results than ordinary laser light. Juan Camilo López Carreño, PhD, demonstrated that such photons (light particles) have superior properties – they do not cluster together in time, but appear in a more ordered fashion and cooperate better with one another.

Such photons approach ideality – they are similar to each other. In practice, photons emitted in this way achieve approximately 95 per cent indistinguishability, whereas with traditional light this value is merely 91 per cent. Additionally, the light takes on a form concentrated within a narrow frequency range, which is of crucial importance for technological applications.

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From Cryptography to Computers – Applications of the Discovery

López Carreño's findings can be applied in future quantum technologies, which may revolutionise telecommunications and computing. Scientists are seeking ways to create better light sources for such devices.

In fact, this represents a step towards building secure communication networks based on quantum mechanics. Light with special properties, which arises from the described research, can be utilised to transmit information in a completely new way – allowing to verify whether it has been intercepted or tampered.

Moreover, efficient single-photon sources are essential for quantum computers of the future. These emitters will be capable of solving problems that are inaccessible to today's computers. López Carreño's research results indicate a path towards creating such sources with better control and quality.

Polish Science at the International Level

The article on López Carreño's research was published in one of the world's most important journals devoted to optics and photonics. This distinction confirms the significance of the conducted research for the international scientific community.

The work was financed with funds from the National Science Centre (NCN) under the prestigious SONATINA project titled "CARAMEL". Juan Camilo López Carreño, PhD works at both the Centre for Theoretical Physics of the Polish Academy of Sciences and the University of Warsaw.

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